New Optical Design and Performance of the NSLS X21 X-Ray Wiggler Beamline

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For 10 years, the X21 x-ray beamline at NSLS, whose radiation source is a hybrid wiggler, was dedicated to inelastic x-ray scattering studies of electronic excitations in condensed matter. Its optical design consisted of a dispersive four-reflection Si(220) monochromator followed by a bent cylindrical mirror, that delivered an energy resolution of 0.2 eV at 8 keV.

The two X21 experimental stations were rebuilt to accommodate new experimental programs that address elastic x-ray scattering studies of materials under high magnetic fields, thin films grown in-situ, and materials studied with small angle x-ray scattering, with appropriate setups permanently installed in the stations. To meet the needs of these programs, the beamline optics have been re-designed. The first component is a new non-dispersive double silicon crystal or multilayer monochromator, which contains selectable pairs of silicon crystals or multilayer elements that can be chosen in-situ to suit the experiment at hand. The first silicon crystal and multilayer element are mounted side-by-side on a helium-gas-cooled cryogenic support, that serves to suppress thermal distortions of the crystal or multilayer when subjected to the 500 W wiggler beam. The monochromatic beam that emanates can be used as is, or further conditioned by the existing four-reflection Si(220) monochromator which remains, if high energy resolution is desired. Finally, the beam is then focused and delivered to the appropriate experimental setup by one of two bent cylindrical mirrors, each of which is shaped to focus the beam into one or the other station.

Performance results and experimental highlights from the first year of operation of this beamline, in its new configuration, will be presented.

Research carried out at NSLS, Brookhaven National Laboratory, which is supported by the US Dept. of Energy, Office of Basic Energy Sciences under Contract No. DE-AC02-98CH10886.

Keywords: synchrotron radiation optics, synchrotron x-ray diffraction, synchrotron x-ray instrumentation